

University of Nebraska - Lincoln

DigitalCommons@University of Nebraska - Lincoln

---

Economics Department Faculty Publications

Economics Department

---

10-2005

## ECONOMIC IMPORTANCE OF IRRIGATED AGRICULTURE 2003

Charles Lamphear

Follow this and additional works at: <https://digitalcommons.unl.edu/econfacpub>



Part of the [Agricultural Economics Commons](#), [Business Commons](#), and the [Public Economics Commons](#)

---

This Article is brought to you for free and open access by the Economics Department at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Economics Department Faculty Publications by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

# **ECONOMIC IMPORTANCE OF IRRIGATED AGRICULTURE**

**2003**

By  
**Charles Lamphear**

For  
**Nebraska Policy Institute**  
Lincoln, Nebraska

**October, 2005**



***NEBRASKA POLICY INSTITUTE***  
***WOULD LIKE TO THANK***  
***THE FOLLOWING FOR CONTRIBUTIONS TO THIS STUDY***

**NPI IRRIGATION STUDY ADVISORY COUNCIL**

Mike Allen – Hastings, Nebraska  
Bill Henry – North Platte, Nebraska  
Tom Kell – Aurora, Nebraska  
Donis Petersan – Columbus, Nebraska

Greg Senkbile – Central City, Nebraska  
Carroll Sheldon – Kearney, Nebraska  
Matt Williams – Gothenburg, Nebraska  
Gene Wray – Scotia, Nebraska

**CONTRIBUTORS**

Aurora Co-op Elevator Company  
Buffalo County Farm Bureau  
Cedar County Farm Bureau  
Central Nebr. Public Power & Irrigation  
Central Platte NRD  
Cheyenne County Farm Bureau  
Custer County Farm Bureau  
Dawson Public Power District  
Dixon County Farm Bureau  
Douglas County Farm Bureau  
Farmers National Company  
Gage County Farm Bureau  
Hall County Farm Bureau  
Heartland Co-op  
Hi-Line Co-op, Inc.  
Iowa-Nebr. Farm Equipment Assn., Inc.  
Keith County Farm Bureau  
Kimball-Banner County Farm Bureau  
Land O' Lakes Foundation

Lincoln County Farm Bureau  
Lindsay Manufacturing  
Merrick County Farm Bureau  
Morrill County Farm Bureau  
Nebraska Bankers Association  
Nebraska Cooperative Council  
Nebraska Farm Bureau Services, Inc.  
Nebraska Public Power District  
Nebraska Rural Electric Association  
Nebraska Water Resources Association  
Nebraska Well Drillers Association  
Rock County Farm Bureau  
Sarpy County Farm Bureau  
Scotts Bluff County Farm Bureau  
Sherman-Valley County Farm Bureau  
Southern Nebr. Rural Public Power District  
Southwest Public Power District  
Upper Loup NRD  
Wayne County Farm Bureau

## **Preface**

Just how important is irrigated agriculture to the Nebraska economy? This question was first addressed nearly forty years ago in a study conducted by Drs. Theodore W. Roesler and F. Charles Lamphear, University of Nebraska Department of Economics. This initial study was updated in 1972 and, again, in 1991.

The latest update study for 2003 was recently completed by Dr. Charles Lamphear, emeritus professor, University of Nebraska-Lincoln (UN-L). He was assisted by emeritus professors Dr. Roy Frederick, UN-L Department of Agriculture Economics and Dr. Dale Flowerday, UN-L Department of Agronomy and Horticulture, along with several UN-L extension specialists.

The results of the 2003 study are summarized in this report. As principal investigator, Dr. Charles Lamphear takes full responsibility for the study's methodology, data, and findings.

## **Current Economic Impact of Irrigated Crop Production**

### **Introduction**

The 2003 irrigation study provides an accounting of the total impact that irrigated agriculture has on the Nebraska economy. Economic impact estimates were calculated for two scenarios. The first scenario assumed normal precipitation prior and during the 2003 crop growing season. The second scenario considered the drought conditions that actually occurred prior and during the 2003 growing season. The purpose for the two scenarios was to give a full accounting of irrigated agriculture's importance to the state's economy.

For both scenarios, total economic impact was defined to include three economic effects: direct effect, indirect effect, and consumption effect. Direct economic effect was defined as the 2003 value of crop output. Indirect economic effect was defined as the business-to-business purchases/sales generated by crop production activity. The consumption effect was defined as the economic activity generated from the personal spending of earned income. Total economic impact is the sum of direct effect, indirect effect, and consumption effect.

The direct effect was measured in terms of the value of crop production for 2003. Total economic impact was measured in four ways: gross output, value added, employment, and earned income. Each of these measures provides an alternative way of expressing total economic impact. Gross output is defined as businesses' sales or receipts plus inventory change. Value-added is defined as gross output minus intermediate inputs (goods and service inputs purchased from suppliers). It represents the value that is added by the application of capital, labor, and management to intermediate inputs in converting those inputs (e.g., fertilizer and fuel) to a finished product (e.g., corn for grain). Employment includes both full- and part-time workers. Earned income includes wages and salaries and proprietors' income. Earned income is less than total personal income, since it excludes dividends and interest income and transfer payments, such as Social Security payments.

The methodology for measuring the direct effect involved the identification of crops and the estimation of yields for irrigated and equivalent dryland crop production. Irrigated crops included corn for grain, soybeans, grain sorghum, winter wheat, dry edible beans, sugar beets, corn for silage, and alfalfa hay. The equivalent dryland crops included corn for grain, soybeans, grain sorghum, alfalfa hay, corn silage, winter wheat, sunflowers, and summer forage.

## Scenario One: Normal Precipitation

### Direct Economic Effect

Crop specific time-series regression equations were developed to estimate irrigated and equivalent dryland crop yields for assumed normal precipitation for 2003. Basically, the equations accounted for changes in technology (e.g., changes in farming practices) and annual precipitation.

Regression estimated crop yields for irrigated and equivalent dryland crops are given in column 2 of Tables 1 and 2. Column 3 of Tables 1 and 2 gives estimates of total crop production. Multiplying actual average price (column 4) times estimated production (column 3) determined the total value of production (column 5). The estimated total value of irrigated crop production was slightly more than \$3.1 billion (Table 1). A comparable estimate for equivalent dryland crop production was approximately \$1.9 billion (Table 2). The \$3.1 billion and \$1.9 billion are the direct effects of irrigated and equivalent dryland crop production, respectively, for the assumed normal precipitation for 2003. The difference of \$1.2 billion (\$3.1 billion - \$1.9 billion = \$1.2 billion) is the net direct economic effect of irrigation.

It should be noted that the total harvested acres for irrigated crops and equivalent dryland crops differs by 103,976 acres (column 1, Tables 1 and 2). The difference represents the estimate of the number of irrigated acres that would convert to summer fallow for equivalent dryland crop production.

**Table 1**  
**Irrigated Crops Output for Normal Weather Conditions: 2003**

	Acres Harvested	Estimated Yield	Total Production	Ave. Price per Unit	Total Value of Production
Crop	1	2	3	4	5
Corn for Grain	4,765,000	185.5	883,907,500	\$2.39	\$2,112,538,925
Soybeans	1,940,000	53.5	103,790,000	\$7.02	\$728,605,800
Grain Sorghum	50,000	117	5,850,000	\$2.35	\$13,747,500
Winter Wheat	185,000	67	12,395,000	\$3.22	\$39,911,900
Dry Edible Beans	148,000	2.129	315,092	\$17.00	\$5,356,564
Alfalfa Hay	500,000	4.9	2,450,000	\$65.50	\$160,475,000
Corn Silage	115,000	19.6	2,254,000	\$23.90	\$53,870,600
Sugarbeets	42,400	20.3	860,720	\$42.30	\$36,408,456
Total	7,745,400				\$3,150,914,745

Source: Derived from data published by the U.S. Department of Agriculture.

**Table 2**  
**Equivalent Dryland Crop Output for Normal Weather Conditions: 2003**

Crop	Acres Harvested 1	Estimated Yield 2	Total Production 3	Ave. Price per Unit 4	Total Value of Production 5
Corn for Grain	4,765,000	106.7	508,425,500	\$2.39	\$1,215,136,945
Soybeans	1,940,000	38.3	74,302,000	\$7.02	\$521,600,040
Grain Sorghum	50,000	87.1	4,355,000	\$2.35	\$10,234,250
Winter Wheat	144,492	43.6	6,299,851	\$3.22	\$20,285,521
Alfalfa Hay	500,000	2.92	1,460,000	\$65.50	\$95,630,000
Corn Silage	115,000	10.5	1,207,500	\$23.90	\$28,859,250
Sunflowers	63,466	9.34	592,772	\$10.70	\$6,342,665
Summer Forage	63,466	1.4	88,852	\$50.50	\$4,487,046
Total	7,641,424				\$1,902,575,717

Source: Derived from data published by the U.S. Department of Agriculture.

#### Total Economic Impact

As defined earlier, total economic impact is the sum of the direct effect, indirect effect, and consumption effect. Total impact can be calculated by determining industry multipliers from an input-output model of the state. These multipliers are numbers (greater than one) that when multiplied times an industry's direct effect, give an estimate of the total impact realized in the economy.

The economic impacts of irrigated and equivalent dryland crop production were estimated with industry multipliers developed from the IMPLAN PRI<sup>TM</sup> (IMPLAN) software and associated data bases plus data collected from an irrigation survey. MIG, Inc. (Stillwater, MN) compiles economic data bases for U.S. counties and states using the North American Industry Classification System (NAICS). Data sources include the U.S. Department of Commerce, the U.S. Bureau of Labor Statistics, and other federal and state agencies.

MIG, Inc. does not disaggregate crop production between irrigated and dryland production. In order to incorporate crop irrigation into the state input-output model, a survey of crop irrigation expenses was conducted. A sample of 108 irrigators was drawn, and each irrigator was mailed a survey for 2003 irrigation expenses. The response rate of 36 percent was adequate to estimate 2003 crop irrigation expenses for Nebraska. These estimated production expenses were incorporated into the IMPLAN system, which then made it possible to calculate economic multipliers for both irrigated crop production and equivalent dryland crop production for 2003.

For assumed normal precipitation, estimated total value of irrigated crop production for 2003 (the direct effect) was slightly less than \$3.2 billion (\$3,150,914,745; Table 1). Using irrigation's economic multiplier of 2.46 from the state input-output model, the total economic impact of irrigation's \$3.15 output was estimated at \$7.76 billion (column 1, Table 3).

A similar total economic impact was calculated for the equivalent dryland crop output. The estimated total value for the equivalent dryland crop production for 2003 was \$1.9 billion (\$1,912,575,717; Table 2). Using dryland crop's economic multiplier of 2.15 from the state input-output model, total economic impact was estimated to be slightly more than \$4.1 billion (\$4,118,210,466; column 1, Table 3). Measured in terms of gross output, the net total economic impact of irrigation for 2003 was slightly more than \$3.6 billion (\$7,761,485,086 - \$4,118,210,466 = \$3,643,274,620) (column 1, Table 3).

The alternative measures of total economic impact, i.e., value added, employment, and earned income are given in columns 2, 3, and 4 of Table 3. Total economic impacts disaggregated on the basis of industry sectors are given in Panels A, B, and C of the Appendix.

The irrigation output multiplier of 2.46 calculated for this study is significantly higher than the estimated output multiplier 2.21 for the 1991 irrigation impact study based on 1985 data. The main reason for the difference was the increased use of professional services. Survey results for the current study indicated that irrigators devoted a higher proportion of total expenditures to professional services, such as accounting and management services. The output multiplier for equivalent dryland crop output increased from 2.07 (1991 study) to 2.15 (current study).

**Table 3**  
**Total Economic Impact for Normal Weather Conditions**

	Gross Output 1	Value Added 2	Employ- ment 3	Earned Income 4
Irrigated Crops	\$7,761,485,086	\$3,887,133,694	78,457	\$2,438,004,651
Equivalent Dryland Crops	\$4,118,210,466	\$2,030,063,452	42,622	\$1,219,620,934
Difference	\$3,643,274,620	\$1,857,070,242	35,835	\$1,218,383,717

Source: Derived from the Nebraska input-output model.



## Scenario Two: Actual Precipitation

### Direct Economic Effect

The actual annual precipitation in Nebraska for 2003 was a recorded 20.06 inches, making it the eighth lowest annual total for the 45-year period from 1960 through 2004. For 2002, the annual total was 15.92 inches making that total the second lowest for the 45-year period. The drought conditions that prevailed in 2002 substantially impacted the 2003 dryland crop output, because of very low subsoil moisture conditions for the 2003 planting season.

Tables 4 and 5 show the same irrigated and equivalent dryland crops, respectively, that were used for the impact estimates for assumed normal precipitation (Tables 1 and 2). The harvested acres (column 1 of Tables 4 and 5) also are identical to the acreages given in Tables 1 and 2. Column 2 of Tables 4 and 5 give crop yields. These estimates are state average yields for 2003. Crop prices given in column 4 of the tables are the same prices shown in column 4 of Tables 1 and 2. The estimated total value of irrigated crop production for 2003 was approximately \$3.15 billion (column 5, Table 4). The estimated total value of equivalent dryland crop production for 2003 was about \$1.49 billion (column 5, Table 5). The \$3.15 billion and the \$1.49 billion estimates are the direct effects for irrigated and equivalent dryland crop production for actual 2003 precipitation. The net direct effect of irrigation of \$1.6 billion (\$3.15 billion - \$1.49 billion = \$1.66 billion) is approximately \$400 million more than the net direct effect of irrigation for the assumed 2003 normal precipitation.

**Table 4**  
**Irrigated Crops for Actual Weather Conditions: 2003**

Crop	Acres Harvested 1	Estimated Yield 2	Total Production 3	Ave. Price per Unit 4	Total Value of Production 5
Corn for Grain	4,765,000	186	883,907,500	\$2.39	\$2,112,538,925
Soybeans	1,940,000	54	103,790,000	\$7.02	\$728,605,800
Grain Sorghum	50,000	117	5,850,000	\$2.35	\$13,747,500
Winter Wheat	185,000	67	12,395,000	\$3.22	\$39,911,900
Dry Edible Beans	148,000	2	315,092	\$17.00	\$5,356,564
Alfalfa Hay	500,000	5	2,450,000	\$65.50	\$160,475,000
Corn Silage	115,000	19	2,208,000	\$23.90	\$52,771,200
Sugarbeets	42,400	20	860,720	\$42.30	\$36,408,456
<b>Total</b>	<b>7,745,400</b>				<b>\$3,149,815,345</b>

Source: Derived from data published by the U.S. Department of Agriculture.

**Table 5**  
**Equivalent Dryland Crop Output for Actual Weather Conditions: 2003**

Crop	Acres Harvested 1	Estimated Yield 2	Total Production 3	Ave. Price per Unit 4	Total Value of Production 5
Corn for Grain	4,765,000	82	390,730,000	\$2.39	\$933,844,700
Soybeans	1,940,000	29.7	57,618,000	\$7.02	\$404,478,360
Grain Sorghum	50,000	55.9	2,795,000	\$2.35	\$6,568,250
Winter Wheat	144,492	43.6	6,299,851	\$3.22	\$20,285,521
Alfalfa Hay	500,000	2.92	1,460,000	\$65.50	\$95,630,000
Corn Silage	115,000	7.5	862,500	\$23.90	\$20,613,750
Sunflowers	63,466	9.34	592,772	\$10.70	\$6,342,665
Summer Forage	63,466	1.4	88,852	\$50.50	\$4,487,046
Total	7,641,424				\$1,492,250,292

Source: Derived from data published by the U.S. Department of Agriculture.

### Total Economic Impact

The gross output, value added, employment, and earned income measures of total economic impact for irrigated crops and equivalent dryland crops for actual 2003 precipitation are given in Table 6. Total economic impacts disaggregated on the basis of industry sectors are given in Panels D, E, and F of the Appendix.

The net total economic impact of irrigation for actual 2003 precipitation is substantially higher than that for assumed normal 2003 precipitation. The reason for the higher net total economic impact is irrigated crop yields are less affected by fluctuations in annual precipitation than are dryland crop yields. A comparison of irrigated and dryland yield variability is presented in the following section.

**Table 6**  
**Total Economic Impact for Actual Weather Conditions: 2003**

	Gross Output	Value Added	Employ- ment	Earned Income
Irrigated Crops	\$7,758,776,991	\$3,885,777,417	78,430	\$2,437,153,996
Equivalent Dryland Crops	\$3,230,042,682	\$1,592,242,953	33,430	\$956,587,261
Difference	\$4,528,734,309	\$2,293,534,464	45,000	\$1,480,566,735

Source: Derived from the Nebraska input-output model.

### **Irrigated and Dryland Crop Yield Variability**

Crop yield variability was measured by calculating average deviations for both dryland and irrigated crop yields for the period 1982 through 2000. The 1982-2000 period was considered sufficient to give reasonably reliable estimates of crop yield variability plus the data represent a recent time period. Crop yield variability measures for the selected crops including corn for grain, soybeans, grain sorghum, winter wheat, corn for silage, and alfalfa hay are presented in Tables 12 through 17 of the Appendix. Table 12 of the Appendix is repeated below as Table 7 to illustrate how crop yield variability was measured.

Table 7 shows that during the period 1982 through 2000, dryland corn average yields varied from a high of 117.2 bushels in 1992 to a low of 58.4 bushels in 1983. Much of that variation was due to fluctuations in weather conditions. Irrigated corn average yields varied from a high of 161.3 bushels in 1998 to a low of 110.9 bushels in 1993.

Trend yield estimates (columns 2 and 5, Table 7) were used to measure the amount that actual yields varied from trend (or, average). Annual deviations (disregarding sign) were totaled and then divided by the total number of years to give an overall measure of variability. This overall measure of variability is called the average deviation. The average deviation for dryland corn was 13.4 bushels. The average deviation for irrigated corn was 8 bushels. For comparative purposes, average deviations were converted to percentages, called relative measures of average deviation. The relative average deviation for dryland corn was calculated by dividing the average deviation of 13.4 bushels by the median trend yield of 91.7 bushels; then, multiplying the result times 100. The relative average deviation for dryland corn yields was 14.6 percent, while the relative average deviation for irrigated corn was only 5.6 percent (Table 7). A comparison of crop yield variability for the selected irrigated and dryland crops

are given in Table 8. The yield data and calculations used in deriving the relative measures of variability (Table 8) are given in Tables 12 through 17 of the Appendix.

Reductions in yield variability through irrigation have resulted in providing the state's agribusiness processors a stable and reliable source of input. This means hundreds of millions of dollars in additional value added and earned income and thousands of additional jobs for Nebraska businesses and workers.

**Table 7**  
**Yield Variability of Corn for Grain: 1985-2000**

<u>Dryland Corn Yields</u>				<u>Irrigated Corn Yields</u>			
Year	Actual Yield 1	Baseline Yield 2	Deviation from Baseline 3	Year	Actual Yield 4	Baseline Yield 5	Deviation from Baseline 6
1982	84.6	77.7	6.9	1982	123	129.2	-6.2
1983	58.4	79.3	-20.9	1983	116	130.7	-14.7
1984	78.4	80.8	-2.4	1984	134	132.1	1.9
1985	99.5	82.4	17.1	1985	141.5	133.6	7.9
1986	100.7	83.9	16.8	1986	140.5	135.1	5.4
1987	92.5	85.5	7	1987	148	136.6	11.4
1988	73.4	87	-13.6	1988	146	138.1	7.9
1989	67.3	88.6	-21.3	1989	142.5	139.5	3
1990	88.7	90.1	-1.4	1990	145.5	141	4.5
1991	77.2	91.7	-14.5	1991	150.5	142.5	8
1992	117.2	93.2	24	1992	143.5	144	-0.5
1993	90	94.8	-4.8	1993	110.9	145.5	-34.6
1994	113	96.3	16.7	1994	152.6	147	5.6
1995	73	97.9	-24.9	1995	130.1	148.4	-18.3
1996	115	99.4	15.6	1996	156.4	149.9	6.5
1997	99	101	-2	1997	151.6	151.4	0.2
1998	119	102.5	16.5	1998	161.3	152.9	8.4
1999	111	104.1	6.9	1999	159.4	154.4	5
2000	84	105.6	-21.6	2000	154.4	155.8	-1.4
Total			254.9	Total			151.4

$$\text{A.D.} = 254.9/19 = 13.4 \text{ bushels}$$

$$\text{A.D.} = 151.4/19 = 8 \text{ bushels}$$

$$\text{Relative A.D.} = 13.4/91.7 \times 100 = 14.6\%$$

$$\text{Relative A.D.} = 8/142.5 \times 100 = 5.6\%$$

Source: Derived from data published by the U.S. Department of Agriculture.

**Table 8**  
**Dryland and Irrigated Yield Variability by Crop: 1982-2000**

Crop	Dryland Percent A.D.	Irrigated Percent A.D.	Percent Reduction in Variability
Corn for Grain	14.6%	5.6%	61.6%
Soybeans	13.9%	5.4%	61.1%
Grain Sorghum	14.4%	7.6%	47.2%
Winter Wheat	11.0%	8.7%	20.9%
Corn for Silage	15.6%	5.0%	67.9%
Alfaifa Hay	7.9%	2.9%	63.8%

Source: From Tables 12-17 of the Appendix.

## Total Economic Impact of New Farm Machinery and Other New Equipment Purchases

The irrigation survey for 2003 irrigated crop expenditures included a section on purchases of new farm machinery and equipment for 2003. The survey results on capital expenditures were extrapolated to a state estimate of \$444.4 million for new farm machinery and equipment purchases during 2003. Examples of farm equipment include irrigation pumps and motors, irrigation pipe, and hand held power tools. Examples of farm machinery include combines, corn planters, and tractors. Added to the \$444.4 million was \$981,000 for computer equipment (Table 9) for an estimated total expenditure of \$445,434,685. The \$981,000 was reported in the *2002 Census of Agriculture for Nebraska*, and it was assumed that 2003 computer expenditures remained at the 2002 level.

**Table 9**  
**New Farm Machinery and Other New Equipment Purchases**  
**By Irrigators: 2003**

Type of Purchase	Estimated Total Value of Purchases
New Farm Machinery	\$278,506,662
Other New Equipment	\$165,947,023
Computer & Related Items	\$981,000

Source: Derived from survey data and published data from the U.S. Department of Agriculture.

Some of the new machinery and equipment purchases were made directly from manufacturers that included manufacturers located outside Nebraska. Other purchases were made through wholesalers, retailers, or both. Assumptions were used to separate in-state suppliers from out-of-state suppliers (Table 10). These assumptions were necessary to calculate the total economic impact associated with purchases from in-state suppliers.

A state input-output model was used to calculate total economic impact for Nebraska. Total economic impact was measured in terms of gross output, value added, employment, and earned income (Table 11). Total economic impacts disaggregated on the basis of industry sectors are presented in Table 18 of the Appendix.

**Table 10**  
**Manufacturer and Distribution Location Assumptions: 2003**

	Manufacturing		Distribution (100% in-state)	
	In-state	Out-of-State	Wholesale	Retail
Implements	20%	80%	100%	0%
Equipment	80%	20%	75%	25%
Computer Hardware	5%	95%	0%	100%

Source: Assumptions

The total economic impact of \$293 million (gross output) is slightly less than two-thirds of the direct expenditures of \$445.4 million (Table 9). This result shows that a very large portion of the \$445.4 million involved out-of-state manufacturers. Payments to out-of-state manufacturers represent transaction leakages from the state's economy.

**Table 11**  
**Total Economic Impact of Capital Expenditures: 2003**

Impact Measure	Impact
Gross Output	\$293,043,049
Value Added	\$167,260,011
Employment	3,289
Earned Income	\$154,636,684

Source: Derived from Nebraska input-output model.

# **APPENDIX**



**Panel A. Gross Output Impact for Normal Weather, 2003**

**Irrigated Crops**

**Total Gross Output Impact by Industry Sector**

Crop Production	\$3,210,613,484
Livestock and Livestock Products	\$32,001,586
Agriculture Processing	\$182,007,678
Other Manufacturing	\$648,117,062
Wholesale and Retail Trade	\$821,907,745
Transportation and Communications	\$354,218,640
Utilities	\$253,753,316
F.I.R.E., Leasing and Rentals	\$969,461,597
Services and Education	\$1,201,006,983
Other	\$88,396,994
<b>Total Gross Output</b>	<b>\$7,761,485,086</b>

**Equivalent Dryland Crops**

**Gross Output Impact by Industry Sector**

Crop Production	\$1,942,853,632
Livestock and Livestock Products	\$17,440,857
Agriculture Processing	\$91,100,805
Other Manufacturing	\$268,181,974
Wholesale and Retail Trade	\$368,503,731
Transportation and Communications	\$162,805,882
Utilities	\$86,665,985
F.I.R.E., Leasing and Rentals	\$519,992,133
Services and Education	\$608,029,362
Other	\$52,636,105
<b>Total Gross Output</b>	<b>\$4,118,210,466</b>
<b>Total Personal Income</b>	<b>\$1,219,620,934</b>

**Net Gross Output Impact by Industry Sector**

**(Irrigation Gross Output - Equivalent Dryland Gross Output)**

Crop Production	\$1,267,759,852
Livestock and Livestock Products	\$14,560,729
Agriculture Processing	\$90,906,873
Other Manufacturing	\$379,935,088
Wholesale and Retail Trade	\$453,404,014
Transportation and Communications	\$191,412,758
Utilities	\$167,087,331
F.I.R.E., Leasing and Rentals	\$449,469,464
Services and Education	\$592,977,621
Other	\$35,760,889
<b>Total Net Gross Output</b>	<b>\$3,643,274,619</b>

Source: Derived from Nebraska input-output model.

**Panel B. Value Added Impact for Normal Weather, 2003****Irrigated Crops****Value Added Impact by Industry Sector**

Crop Production	\$1,393,600,344
Livestock and Livestock Products	\$3,179,198
Agriculture Processing	\$44,103,804
Other Manufacturing	\$193,748,592
Wholesale and Retail Trade	\$604,712,903
Transportation and Communications	\$185,433,725
Utilities	\$190,796,359
F.I.R.E., Leasing and Rentals	\$529,260,596
Services and Education	\$703,671,244
Other	\$38,626,930
Total Value Added	\$3,887,133,694

**Equivalent Dryland Crops****Value Added Impact by Industry Sector**

Crop Production	\$843,225,989
Livestock and Livestock Products	\$1,732,662
Agriculture Processing	\$22,045,389
Other Manufacturing	\$81,414,305
Wholesale and Retail Trade	\$270,967,933
Transportation and Communications	\$85,104,481
Utilities	\$64,134,789
F.I.R.E., Leasing and Rentals	\$283,952,535
Services and Education	\$355,067,444
Other	\$22,417,925
Total Value Added	\$2,030,063,452
Total Personal Income	\$1,219,620,934

**Net Value Added Impact by Industry Sector****(Irrigation V.A. - Dryland Equivalent V.A.)**

Crop Production	\$550,374,355
Livestock and Livestock Products	\$1,446,536
Agriculture Processing	\$22,058,415
Other Manufacturing	\$112,334,287
Wholesale and Retail Trade	\$333,744,970
Transportation and Communications	\$100,329,244
Utilities	\$126,661,570
F.I.R.E., Leasing and Rentals	\$245,308,061
Services and Education	\$348,603,799
Other	\$16,209,005
Total Value Added	\$1,857,070,243

Source: Derived from Nebraska input-output model.

**Panel C. Employment Impact for Normal Weather, 2003**

**Irrigated Crops**

Employment Impact by Industry Sector

Crop Production	29,670
Livestock and Livestock Products	166
Agriculture Processing	593
Other Manufacturing	2,650
Wholesale and Retail Trade	12,696
Transportation and Communications	2,443
Utilities	306
F.I.R.E., Leasing and Rentals	6,920
Services and Education	22,237
Other	776
Total Employment Impact	78,457

**Equivalent Dryland Crops**

Employment Impact by Industry Sector

Crop Production	17,959
Livestock and Livestock Products	91
Agriculture Processing	297
Other Manufacturing	1,109
Wholesale and Retail Trade	5,615
Transportation and Communications	1,120
Utilities	112
F.I.R.E., Leasing and Rentals	3,712
Services and Education	12,117
Other	490
Total Employment Impact	42,622

**Net Employment Impact by Industry Sector**

(Irrigation Employ. - Equivalent Dryland Employ.)

Crop Production	11,711
Livestock and Livestock Products	76
Agriculture Processing	296
Other Manufacturing	1,541
Wholesale and Retail Trade	7,080
Transportation and Communications	1,323
Utilities	194
F.I.R.E., Leasing and Rentals	3,208
Services and Education	10,121
Other	285
Total Net Employment Impact	35,835

Source: Derived from Nebraska input-output model.

**Panel D. Gross Output Impact for Actual Weather, 2003**

**Irrigated Crops**

**Gross Output Impact by Industry Sector**

Crop Production	\$3,209,493,254
Livestock and Livestock Products	\$31,990,420
Agriculture Processing	\$181,944,173
Other Manufacturing	\$647,890,925
Wholesale and Retail Trade	\$821,620,969
Transportation and Communications	\$354,095,048
Utilities	\$253,664,778
F.I.R.E., Leasing and Rentals	\$969,123,338
Services and Education	\$1,200,587,934
Other	\$88,366,151
<b>Total Gross Output</b>	<b>\$7,758,776,991</b>

**Equivalent Dryland Crops**

**Gross Output Impact by Industry Sector**

Crop Production	\$1,523,841,534
Livestock and Livestock Products	\$13,679,415
Agriculture Processing	\$71,453,242
Other Manufacturing	\$210,343,602
Wholesale and Retail Trade	\$289,029,128
Transportation and Communications	\$127,693,801
Utilities	\$67,974,872
F.I.R.E., Leasing and Rentals	\$407,846,271
Services and Education	\$476,896,653
Other	\$41,284,161
<b>Total Gross Output</b>	<b>\$3,230,042,682</b>

**Net Gross Output Impact by Industry Sector**

**(Irrigation Gross Impact - Equivalent Dryland Gross Impact)**

Crop Production	\$1,685,651,720
Livestock and Livestock Products	\$18,311,004
Agriculture Processing	\$110,490,931
Other Manufacturing	\$437,547,323
Wholesale and Retail Trade	\$532,591,842
Transportation and Communications	\$226,401,247
Utilities	\$185,689,906
F.I.R.E., Leasing and Rentals	\$561,277,066
Services and Education	\$723,691,280
Other	\$47,081,990
<b>Total Net Gross Output</b>	<b>\$4,528,734,309</b>

Source: Derived from Nebraska input-output model.

**Panel E. Value Added Impact for Actual Weather, 2003**

**Irrigated Crops**

**Value Added Impact by Industry Sector**

Crop Production	\$1,393,114,097
Livestock and Livestock Products	\$3,178,088
Agriculture Processing	\$44,088,416
Other Manufacturing	\$193,680,991
Wholesale and Retail Trade	\$604,501,910
Transportation and Communications	\$185,369,025
Utilities	\$190,729,787
F.I.R.E., Leasing and Rentals	\$529,075,930
Services and Education	\$703,425,722
Other	\$38,613,452
<b>Total Value Added</b>	<b>\$3,885,777,417</b>

**Equivalent Dryland Crops**

**Value Added Impact by Industry Sector**

Crop Production	\$661,368,805
Livestock and Livestock Products	\$1,358,982
Agriculture Processing	\$17,290,896
Other Manufacturing	\$63,855,814
Wholesale and Retail Trade	\$212,528,717
Transportation and Communications	\$66,750,135
Utilities	\$50,302,943
F.I.R.E., Leasing and Rentals	\$222,712,951
Services and Education	\$278,490,623
Other	\$17,583,087
<b>Total Value Added</b>	<b>\$1,592,242,953</b>

**Net Value Added Impact by Industry Sector**

(Irrigation V.A. Impact - Equivalent Dryland V.A. Impact)

Crop Production	\$731,745,292
Livestock and Livestock Products	\$1,819,107
Agriculture Processing	\$26,797,520
Other Manufacturing	\$129,825,177
Wholesale and Retail Trade	\$391,973,192
Transportation and Communications	\$118,618,889
Utilities	\$140,426,845
F.I.R.E., Leasing and Rentals	\$306,362,978
Services and Education	\$424,935,099
Other	\$21,030,365
<b>Total Net Value Added</b>	<b>\$2,293,534,463</b>

Source: Derived from Nebraska input-output model.

**Panel F. Employment Impact for Actual Weather, 2003**

**Irrigated Crops**

**Employment Impact by Industry Sector**

Crop Production	29,660
Livestock and Livestock Products	166
Agriculture Processing	592
Other Manufacturing	2,649
Wholesale and Retail Trade	12,691
Transportation and Communications	2,442
Utilities	306
F.I.R.E., Leasing and Rentals	6,917
Services and Education	22,230
Other	776
<b>Total Employment Impact</b>	<b>78,430</b>

**Equivalent Dryland Crops**

**Employment Impact by Industry Sector**

Crop Production	14,086
Livestock and Livestock Products	71
Agriculture Processing	233
Other Manufacturing	870
Wholesale and Retail Trade	4,404
Transportation and Communications	878
Utilities	88
F.I.R.E., Leasing and Rentals	2,911
Services and Education	9,503
Other	385
<b>Total Employment Impact</b>	<b>33,430</b>

**Net Employment Impact by Industry Sector**

**(Irrigation Employ. - Equivalent Dryland Employ. )**

Crop Production	15,574
Livestock and Livestock Products	95
Agriculture Processing	360
Other Manufacturing	1,780
Wholesale and Retail Trade	8,287
Transportation and Communications	1,564
Utilities	218
F.I.R.E., Leasing and Rentals	4,006
Services and Education	12,726
Other	391
<b>Total Net Employment Impact</b>	<b>45,000</b>

Source: Derived from Nebraska input-output model.

**Table 12**  
**Yield Variability of Corn for Grain: 1985-2000**

**Dryland Corn Yields**

Year	Actual Yield 1	Baseline Yield 2	Deviation from Baseline 3
1982	84.6	77.7	6.9
1983	58.4	79.3	-20.9
1984	78.4	80.8	-2.4
1985	99.5	82.4	17.1
1986	100.7	83.9	16.8
1987	92.5	85.5	7
1988	73.4	87	-13.6
1989	67.3	88.6	-21.3
1990	88.7	90.1	-1.4
1991	77.2	91.7	-14.5
1992	117.2	93.2	24
1993	90	94.8	-4.8
1994	113	96.3	16.7
1995	73	97.9	-24.9
1996	115	99.4	15.6
1997	99	101	-2
1998	119	102.5	16.5
1999	111	104.1	6.9
2000	84	105.6	-21.6
Total			254.9

**Irrigated Corn Yields**

Year	Actual Yield 4	Baseline Yield 5	Deviation from Baseline 6
1982	123	129.2	-6.2
1983	116	130.7	-14.7
1984	134	132.1	1.9
1985	141.5	133.6	7.9
1986	140.5	135.1	5.4
1987	148	136.6	11.4
1988	146	138.1	7.9
1989	142.5	139.5	3
1990	145.5	141	4.5
1991	150.5	142.5	8
1992	143.5	144	-0.5
1993	110.9	145.5	-34.6
1994	152.6	147	5.6
1995	130.1	148.4	-18.3
1996	156.4	149.9	6.5
1997	151.6	151.4	0.2
1998	161.3	152.9	8.4
1999	159.4	154.4	5
2000	154.4	155.8	-1.4
Total			151.4

A.D. =  $254.9/19 = 13.4$  bushels

A.D. =  $151.4/19 = 8$  Bushels

Relative A.D. =  $13.4/91.7 \times 100 = 14.6\%$

Relative A.D. =  $8/142.5 \times 100 = 5.6\%$

Source: Derived from data published by the U.S. Department of Agriculture.

**Table 13**  
**Yield Variability for Soybeans: 1985-2000**

Dryland Soybean Yields				Irrigated Soybean Yields			
	Actual	Baseline	Deviation		Actual	Baseline	Deviation
	1	2	from		1	2	from
Year	Yield	Yield	Baseline	Year	Yield	Yield	Baseline
1982	36.5	28.8	7.7	1982	45	39	6
1983	33.6	29.3	4.3	1983	41	39.6	1.4
1984	25.3	29.9	-4.6	1984	38	40.2	-2.2
1985	22.3	30.4	-8.1	1985	36	40.8	-4.8
1986	34.5	30.9	3.6	1986	40	41.4	-1.4
1987	36.2	31.5	4.7	1987	44	42	2
1988	33.1	32	1.1	1988	43	42.6	0.4
1989	25.3	32.6	-7.3	1989	43	43.2	-0.2
1990	27	33.1	-6.1	1990	44	43.8	0.2
1991	31	33.7	-2.7	1991	43	44.4	-1.4
1992	28.7	34.2	-5.5	1992	45	45	0
1993	40.8	34.8	6	1993	45	45.6	-0.6
1994	34.1	35.3	-1.2	1994	40.5	46.2	-5.7
1995	44.6	35.9	8.7	1995	53	46.8	6.2
1996	29.1	36.4	7.3	1996	41.5	47.4	-5.9
1997	42.9	37	5.9	1997	50	48	2
1998	36.5	37.5	-1	1998	50	48.6	1.4
1999	40.9	38.1	2.8	1999	51.1	49.3	1.8
2000	37.5	38.6	-1.1	2000	51	49.9	1.1
	Total		89.7		Total		44.7

A.D. =  $89.7/19 = 4.7$  bushels

A.D. =  $44.7/19 = 2.4$  bushels

Relative A.D. =  $4.7/33.7 \times 100 = 13.9\%$

Relative A.D. =  $2.4/44.4 \times 100 = 5.4\%$

Source: Derived from data published by the U.S. Department of Agriculture.



**Table 14**  
**Yield Variability for Grain Sorghum: 1985-2000**

Dryland Grain Sorghum Yields				Irrigated Grain Sorghum Yields			
Year	Actual Yield 1	Baseline Yield 2	Deviation from Baseline 3	Year	Actual Yield 1	Baseline Yield 2	Deviation from Baseline 3
1982	71.1	67.9	3.2	1982	87	90.2	-3.2
1983	58.4	68.8	-10.4	1983	82	90.7	-8.7
1984	60.9	69.7	-8.8	1984	88	91.3	-3.3
1985	78.1	70.6	7.5	1985	95	91.8	3.2
1986	87.6	71.5	16.1	1986	102	92.4	9.6
1987	80.4	72.4	8	1987	98	92.9	5.1
1988	73.8	73.3	0.5	1988	102	93.5	8.5
1989	59	74.1	-15.1	1989	92	94	-2
1990	75.2	75	0.2	1990	98	94.6	3.4
1991	64.5	75.9	-11.4	1991	98	95.1	2.9
1992	93.3	76.8	16.5	1992	101	95.7	5.3
1993	58.3	77.7	-19.4	1993	70	96.2	-26.2
1994	97.4	78.6	18.8	1994	109	96.7	12.3
1995	57	79.5	-22.5	1995	74	97.3	-23.3
1996	94.3	80.3	14	1996	106	97.8	8.2
1997	80.2	81.2	-1	1997	101	98.4	2.6
1998	93.6	82.1	11.5	1998	104	98.9	5.1
1999	90.5	83	7.5	1999	102	99.5	2.5
2000	68.8	83.9	-15.1	2000	98	100	-2
Total			207.5	Total			137.4

$$\text{A.D.} = 207.5/19 = 10.9 \text{ bushels}$$

$$\text{A.D.} = 137.4/19 = 7.2 \text{ bushels}$$

$$\text{Relative A.D.} = 10.9/75.9 \times 100 = 14.4\%$$

$$\text{Relative A.D.} = 7.2/95.1 \times 100 = 7.6\%$$

Source: Derived from data published by the U.S. Department of Agriculture.

**Table 15**  
**Yield Variability for Winter Wheat: 1985-2000**

Dryland Winter Wheat Yields				Irrigated Winter Wheat Yields			
Year	Actual Yield 1	Baseline Yield 2	Deviation from Baseline 3	Year	Actual Yield 1	Baseline Yield 2	Deviation from Baseline 3
1982	34.1	35.4	-1.3	1982	55	50.9	4.1
1983	42.3	35.5	6.8	1983	56	51.3	4.7
1984	34.7	35.7	-1	1984	52	51.8	0.2
1985	38.2	35.8	2.4	1985	55	52.3	2.7
1986	37.3	35.9	1.4	1986	53	52.8	0.2
1987	43.1	36	7.1	1987	60	53.2	6.8
1988	35.6	36.1	-0.5	1988	46	53.7	-7.7
1989	26.2	36.2	-10	1989	47	54.2	-7.2
1990	37.3	36.4	0.9	1990	56	54.6	1.4
1991	31.5	36.5	-5	1991	47	55.1	-8.1
1992	29.3	36.6	-7.3	1992	49	55.6	-6.6
1993	34.2	36.7	-2.5	1993	56	56	0
1994	33.2	36.8	-3.6	1994	55	56.5	-1.5
1995	40	36.9	3.1	1995	62	57	5
1996	34.3	37	-2.7	1996	53	57.5	-4.5
1997	36.3	37.2	-0.9	1997	48	57.9	-9.9
1998	44.5	37.3	7.2	1998	68	58.4	9.6
1999	46.9	37.4	9.5	1999	66	58.9	7.1
2000	33.9	37.5	-3.6	2000	63	59.3	3.7
Total			76.8	Total			91

$$\text{A.D.} = 76.8/19 = 4 \text{ bushels}$$

$$\text{A.D.} = 91/19 = 4.8 \text{ bushels}$$

$$\text{Relative A.D.} = 4/36.5 \times 100 = 11\%$$

$$\text{Relative A.D.} = 4.8/55.1 \times 100 = 8.7\%$$

Source: Derived from data published by the U.S. Department of Agriculture.

**Table 16**  
**Yield Variability for Corn for Silage: 1985-2000**

Dryland Corn for Silage Yields				Irrigated Corn for Silage Yields			
Year	Actual Yield 1	Baseline Yield 2	Deviation from Baseline 3	Year	Actual Yield 1	Baseline Yield 2	Deviation from Baseline 3
1982	10.9	10.5	0.4	1982	17.5	17.5	0
1983	9.7	10.6	-0.9	1983	17.5	17.6	-0.1
1984	10	10.7	0.7	1984	18.5	17.7	0.8
1985	13.5	10.7	2.8	1985	18.5	17.7	0.8
1986	12.5	10.8	1.7	1986	17.5	17.8	-0.3
1987	12.9	10.8	2.1	1987	20	17.9	2.1
1988	9.5	10.8	-1.3	1988	18	17.9	0.1
1989	8.2	10.9	-2.7	1989	17.5	18	-0.5
1990	8.8	10.9	-2.1	1990	17.5	18.1	-0.6
1991	7.8	10.9	-3.1	1991	17.5	18.1	-0.6
1992	12.7	11	1.7	1992	18.5	18.2	0.3
1993	11.2	11	0.2	1993	13.5	18.3	-4.8
1994	13	11	2	1994	18.2	18.3	-0.1
1995	7.8	11.1	-3.3	1995	17	18.4	-1.4
1996	13	11.1	1.9	1996	19.1	18.5	0.6
1997	11.5	11.1	0.4	1997	19.3	18.5	0.8
1998	13.1	11.1	2	1998	20.5	18.6	1.9
1999	12.2	11.2	1	1999	19.5	18.7	-0.8
2000	9.3	11.2	-1.9	2000	19	18.7	-0.3
Total			32.2	Total			16.9

$$\text{A.D.} = 32.2/19 = 1.7 \text{ tons}$$

$$\text{A.D.} = 16.9/19 = 0.9 \text{ tons}$$

$$\text{Relative A.D.} = 1.7/10.9 \times 100 = 15.6\%$$

$$\text{Relative A.D.} = 0.9/18.1 \times 100 = 5\%$$

Source: Derived from data published by the U.S. Department of Agriculture.

**Table 17**  
**Yield Variability for Alfalfa Hay: 1985-2000**

Dryland Alfalfa Hay Yields				Irrigated Alfalfa Hay Yields			
Year	Actual Yield 1	Baseline Yield 2	Deviation from Baseline 3	Year	Actual Yield 1	Baseline Yield 2	Deviation from Baseline 3
1982	3.1	2.96	0.14	1982	4.35	4.21	0.14
1983	2.95	2.97	-0.02	1983	4.3	4.23	0.07
1984	3	2.98	0.02	1984	4.1	4.25	-0.15
1985	3.1	2.99	0.11	1985	4.1	4.28	-0.18
1986	3.15	3	0.15	1986	4.3	4.3	0
1987	3.18	3.01	0.17	1987	4.6	4.32	0.28
1988	2.54	3.02	-0.48	1988	4.3	4.34	-0.04
1989	2.46	3.03	-0.57	1989	4.3	4.37	-0.07
1990	2.94	3.04	-0.1	1990	4.2	4.39	-0.19
1991	2.83	3.05	-0.22	1991	4.5	4.41	0.09
1992	3.44	3.06	0.38	1992	4.5	4.43	0.07
1993	3.17	3.07	0.1	1993	4.1	4.46	-0.36
1994	3.27	3.08	0.19	1994	4.6	4.48	0.12
1995	3.28	3.09	0.19	1995	4.5	4.5	0
1996	3.32	3.1	0.22	1996	4.8	4.52	0.25
1997	2.83	3.11	-0.28	1997	4.45	4.55	-0.1
1998	3.4	3.12	0.28	1998	4.8	4.57	0.23
1999	3.41	3.13	0.28	1999	4.55	4.59	-0.04
2000	2.57	3.14	-0.57	2000	4.45	4.61	-0.16
Total			4.47	Total			2.54

$$\text{A.D.} = 4.47/19 = 0.24 \text{ tons}$$

$$\text{A.D.} = 2.54/19 = 0.13 \text{ tons}$$

$$\text{Relative A.D.} = 0.24/3.05 \times 100 = 7.9\%$$

$$\text{Relative A.D.} = 0.13/4.41 \times 100 = 2.9\%$$

Source: Derived from data published by the U.S. Department of Agriculture.

**Table 18**  
**Economic Impact of Capital Purchases, 2003**

**Total Gross Output Impact by Industry Sector**

Crop Production	\$1,103,183
Livestock & Livestock Products	\$1,934,539
Agriculture Processing	\$11,517,004
Other Manufacturing	\$14,164,054
Wholesale and Retail Trade	\$118,598,092
Transportation and Communications	\$20,318,423
Utilities	\$8,817,101
F.I.R.E., Leasing and Rentals	\$40,021,237
Services and Education	\$75,539,680
Other	\$1,029,736
<b>Total Gross Output</b>	<b>\$293,043,049</b>

**Total Value Added Impact by Industry Sector**

Crop Production	\$549,139
Livestock & Livestock Products	\$192,187
Agriculture Processing	\$2,791,743
Other Manufacturing	\$4,337,916
Wholesale and Retail Trade	\$86,405,971
Transportation and Communications	\$0
Utilities	\$6,476,394
F.I.R.E., Leasing and Rentals	\$21,779,813
Services and Education	\$43,685,293
Other	\$1,041,556
<b>Total Value Added</b>	<b>\$167,260,011</b>

**Total Employment Impact by Industry Sector**

Crop Production	6
Livestock & Livestock Products	10
Agriculture Processing	38
Other Manufacturing	61
Wholesale and Retail Trade	1,413
Transportation and Communications	139
Utilities	12
F.I.R.E., Leasing and Rentals	285
Services and Education	1,304
Other	22
<b>Total Employment Impact</b>	<b>3,289</b>

Source: Derived from the Nebraska input-output model.